Recent MAGIC results on galactic sources

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Outline

MAGIC phase I (2006-2009)

Region of SNR G65.1+0.6

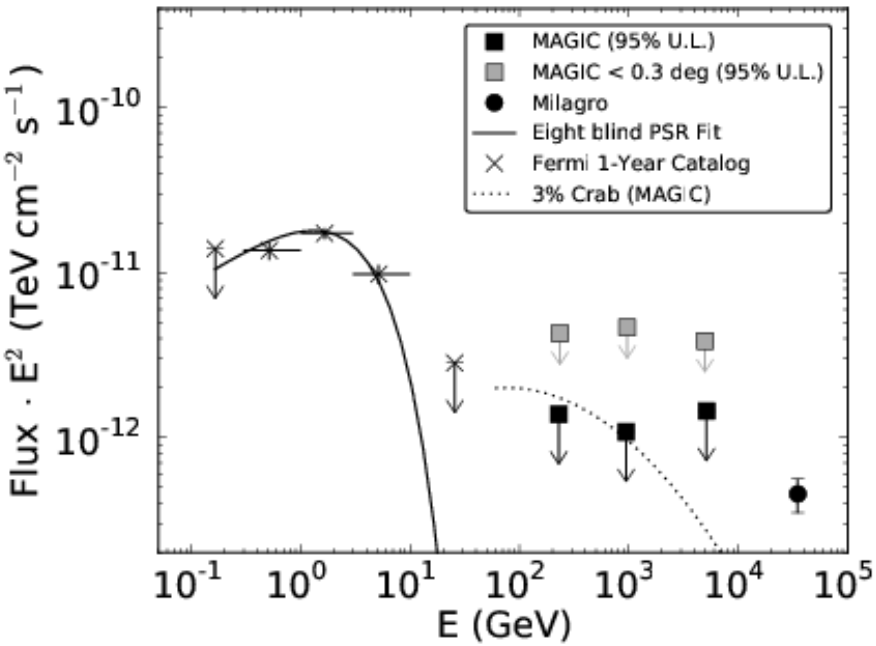
Motivation

- The region contains 2 Milagro-detected Fermi bright sources (Abdo et al. 2009b)
  - 1FGL J1954.3+2836 (4.3 σ by Milagro between 10-50 TeV)
  - 1FGL J1958.6+2845 (4.0 σ by Milagro between 10-50 TeV)
- As of now both sources are identified as gamma-ray pulsars (Abdo et al. 2010)
  - Periods: 290ms, 92.7ms
  - Ages: 69.5kyrs, 21kyrs
  - Cutoffs: 2.9GeV, 1.2GeV

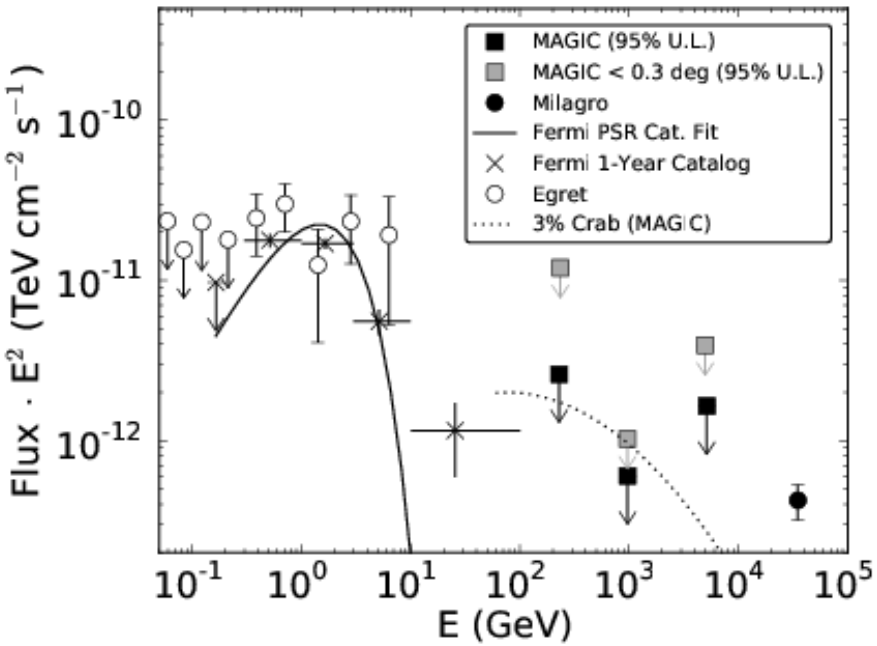
MAGIC obseravtions in 2009

- 25.5h of good quality data
- differential flux upper limits

J1954



J1958

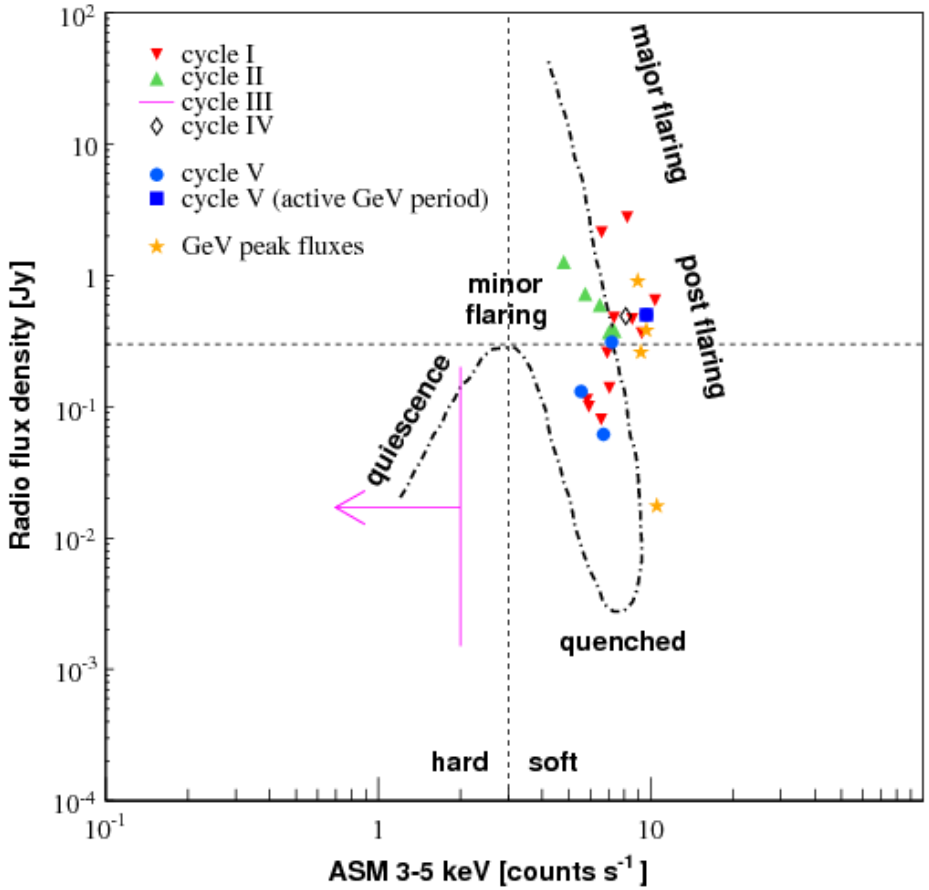


arXiv:1007.3359v1; Abdo et al. 2009b, 2009c, 2010; Albert et al. 2008a; Hartman et al. 1999; Saz Parkinson et al. 2010

Conclusion

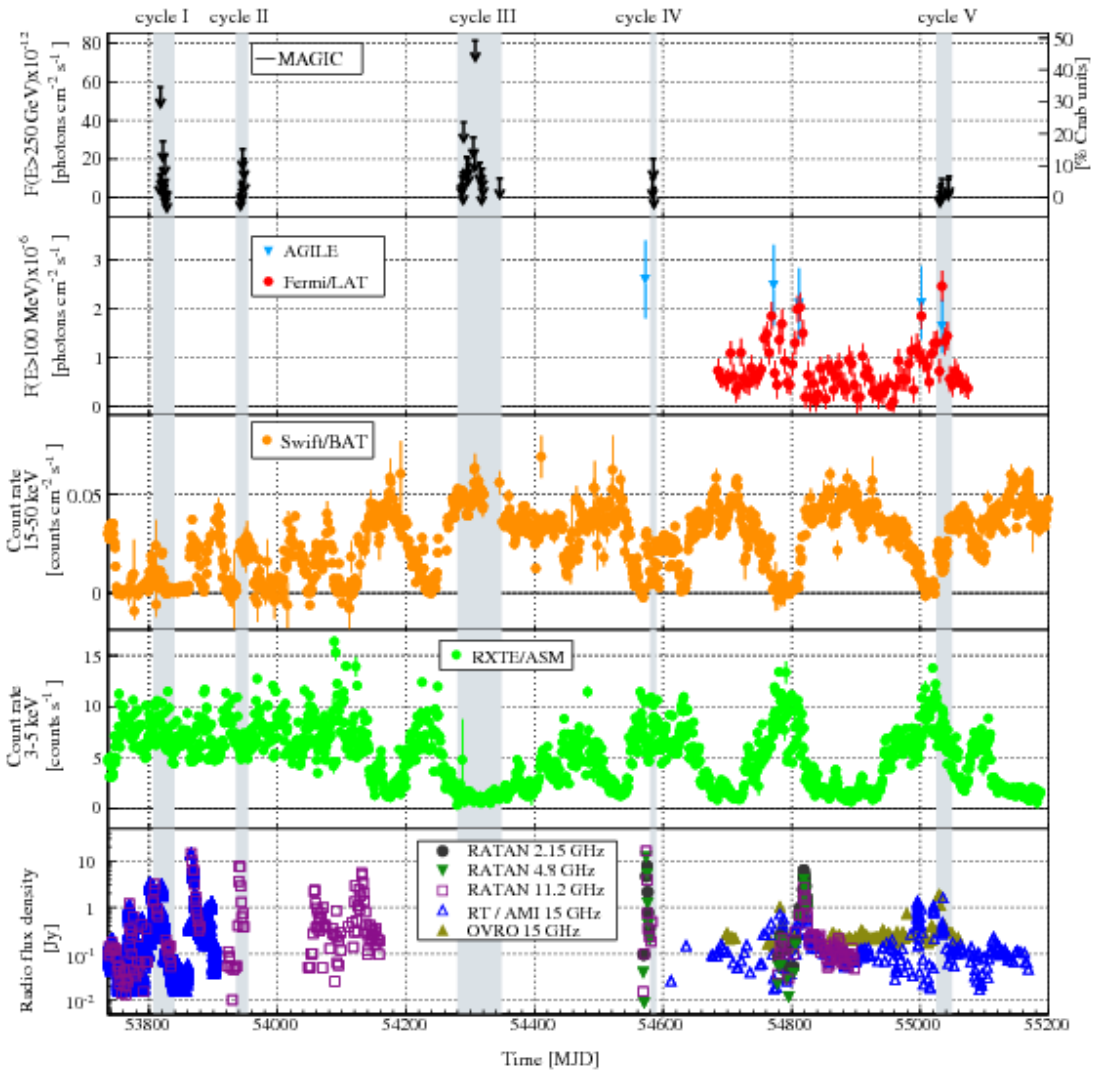
Probably pulsar wind nebula with an inverse Compton peak $>$ 1TeV

Cygnus X-3



- X-ray binary of a Wolf-Rayet star and unknown compact object
- Orbital period: 4.8h

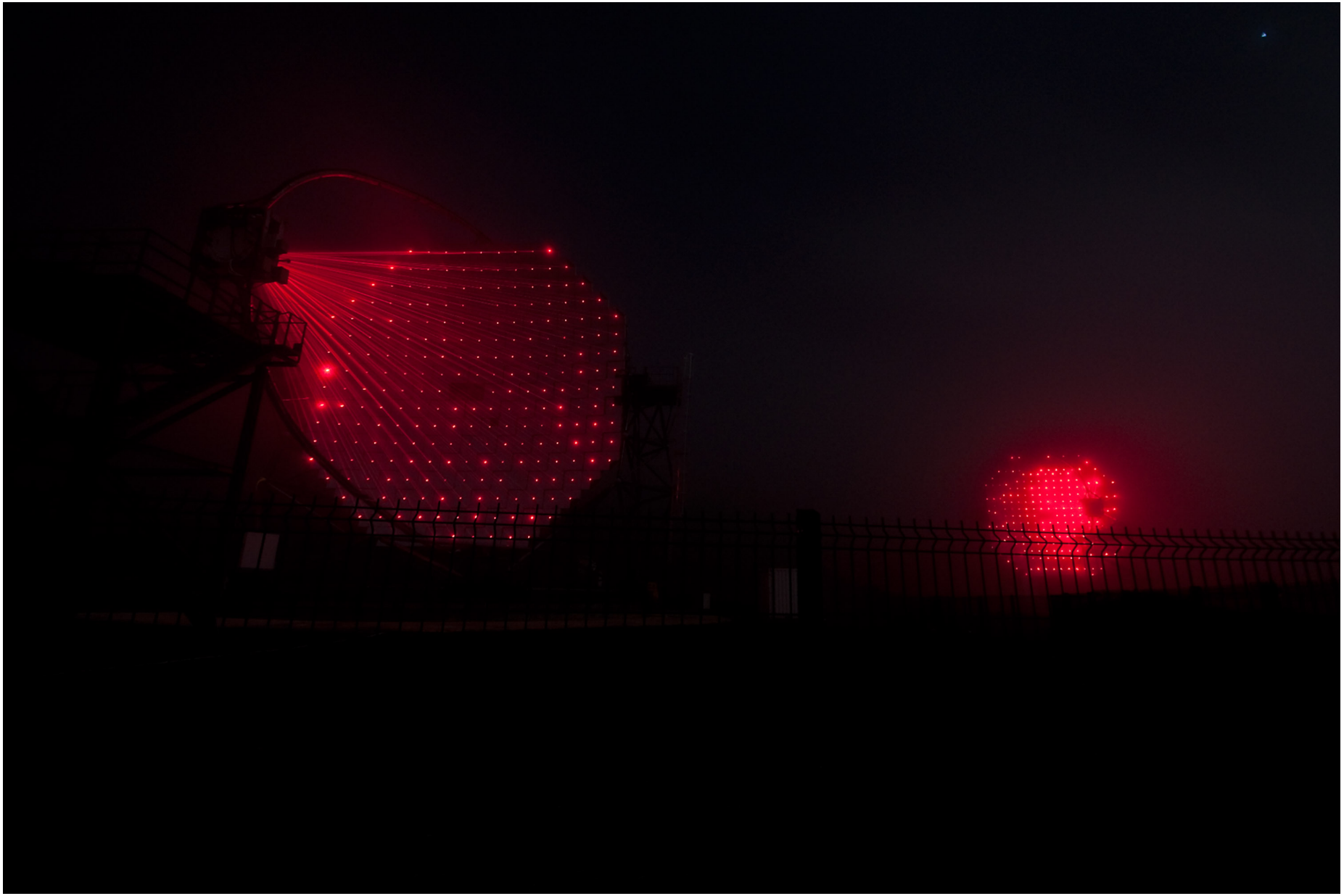
MAGIC campaign over 4 years (2006-2009) for 56.7h



95% CI upper limits
Energy $>$ 250 GeV

- All data: 1.3 % crab
- Soft state: 2.5 % crab
- Hard state: 1.1% crab
- GeV Flare: $<$ 6 % crab

MAGIC phase II (since fall 2009)



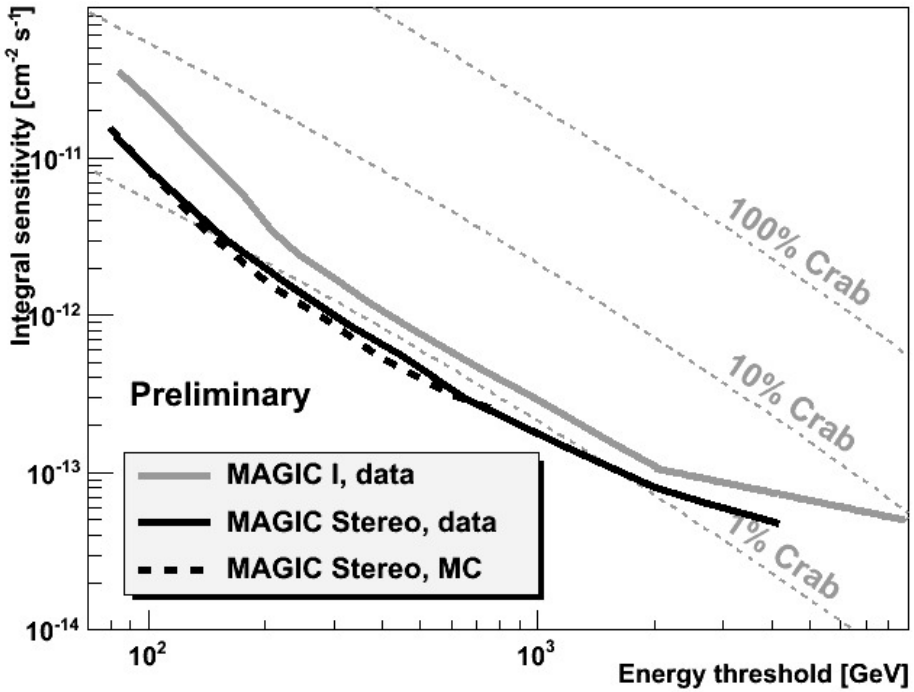
Improvements due to the stereo system

- Stronger Background supression
  - less muons
  - less accidentials
- 3D information of the shower
  - Precise estimation of the shower height maximum
  - Precise estimation of the impact parameter
- Higher energy resolution
- Higher angular resolution
- Better Off-axis performance

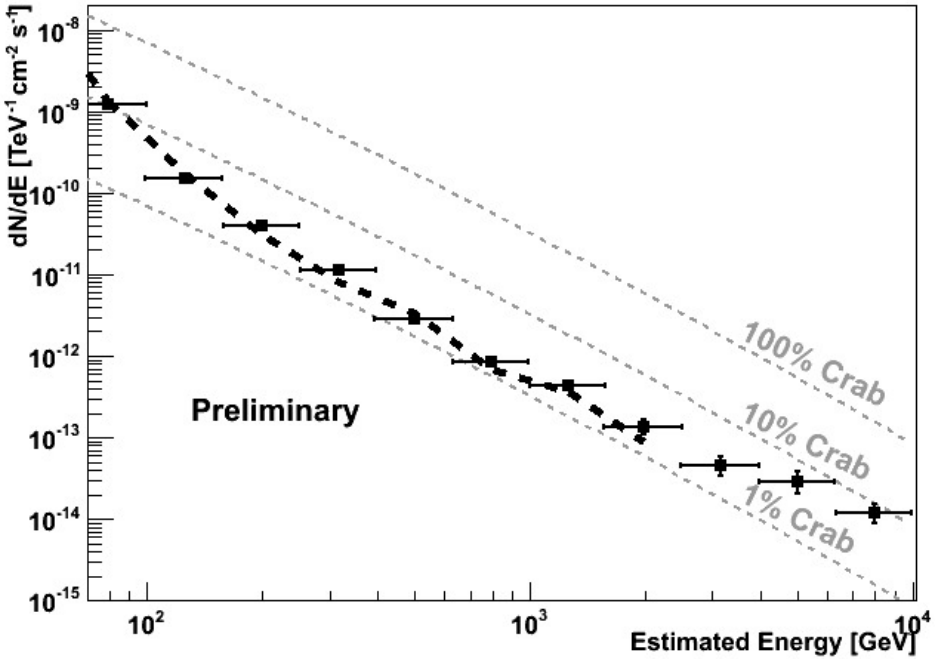
$\Rightarrow$ **Sensitivity improves by a factor $\approx$ 2**

Sensitivity curves

Integral



Differential

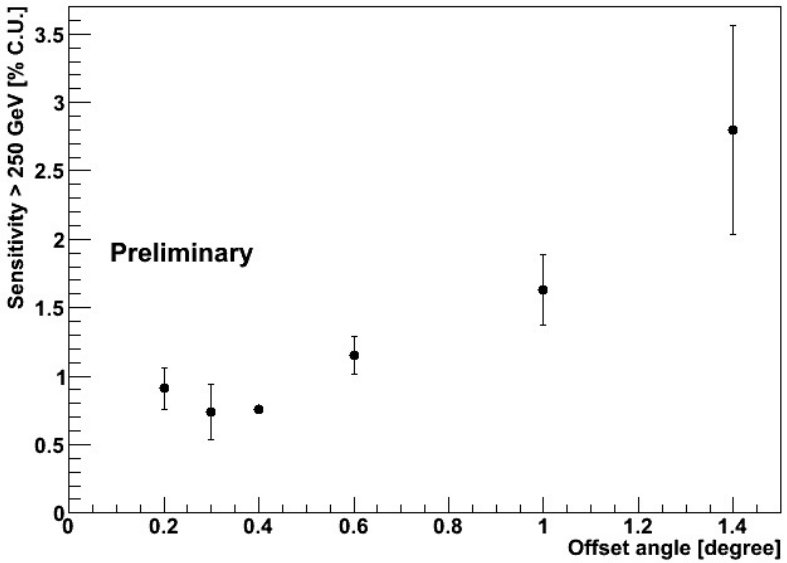


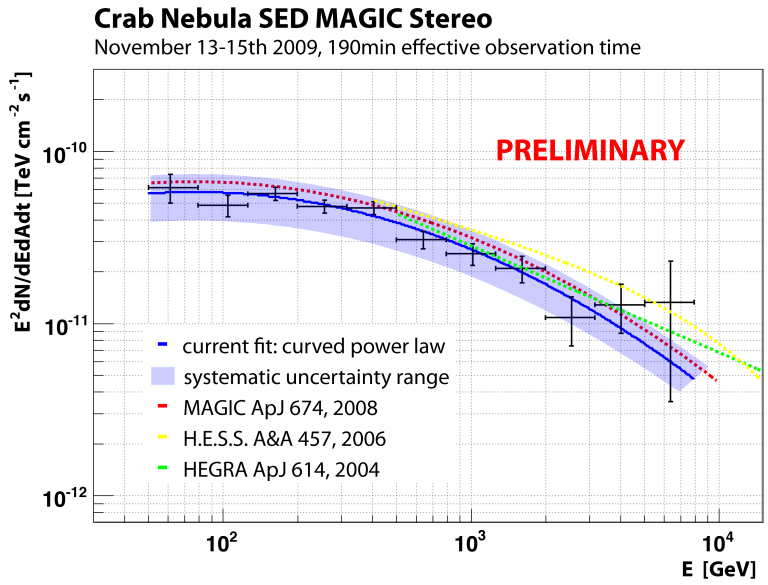
- 0.8 % Crab above 250 GeV
- Sensitivity is calculated as $\mathrm{N_{excess}}/\sqrt{\mathrm{N_{bgd}}} = 5$ after 50 hours
- Differential sensitivity additionaly requires a
  - Minimum of 10 Excess events
  - Signal $\geq$ 5% background

Benefit for galactic sources

- Improved performance for
  - Off-axis sources
  - Extended sources
  - Variable sources
- Allows for
  - Morphological studies
  - High resolution spectra

Off-axis performance





LSI+61 303

- System of a Be star and a compact object of unknown nature
- Orbital period in radio of 26.4960 ± 0.028 days (Gregory 2002)
- Soft x-ray outburst modulated by orbital period (Paredes et al. 1997)
- Indication that X-ray outbursts change phases over the years (Torres et al. 2010)

VHE gamma-rays

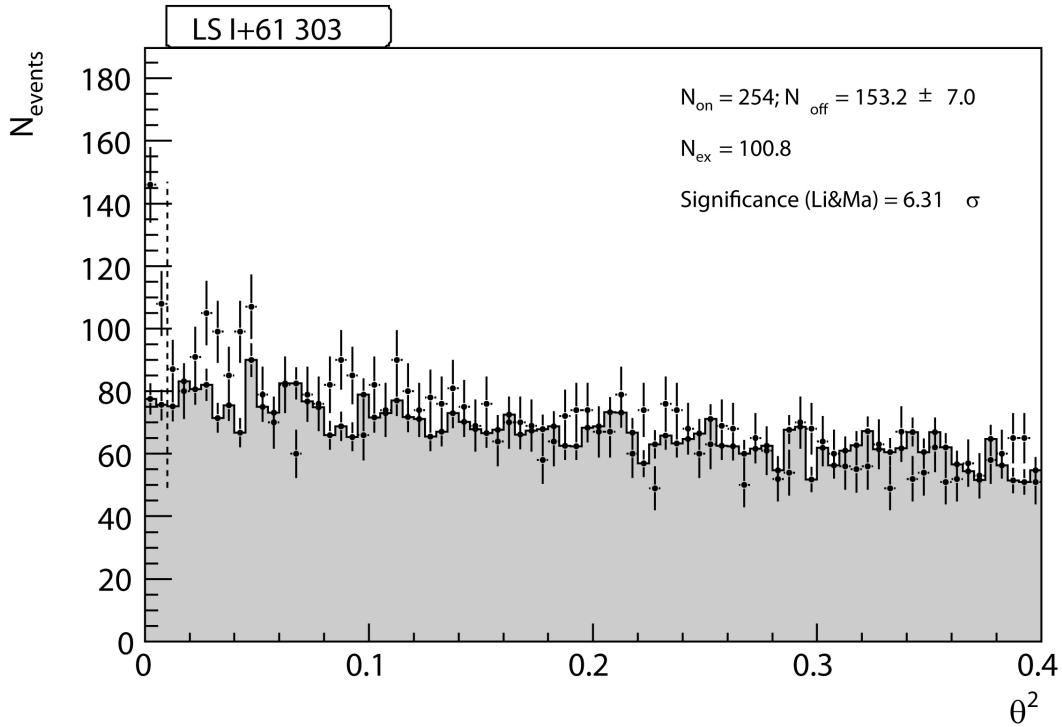
- System discovered by MAGIC in 2006 (Albert et al. 2006, Anderhub et al. 2009)
  - Orbital period: 26.6 ± 0.2 days
  - Outburst in orbital phase interval 0.6-0.7 (periastron 0.275)
  - strong evidence for X-ray/gamma-ray correlation
- Emission confirmed by VERITAS in 2007 (Acciari et al. 2008)
  - Fall 2008 to early 2009 no detection
  - Fall 2009 no detection

MAGIC Observations from 2009/10/15 to 2010/01/22

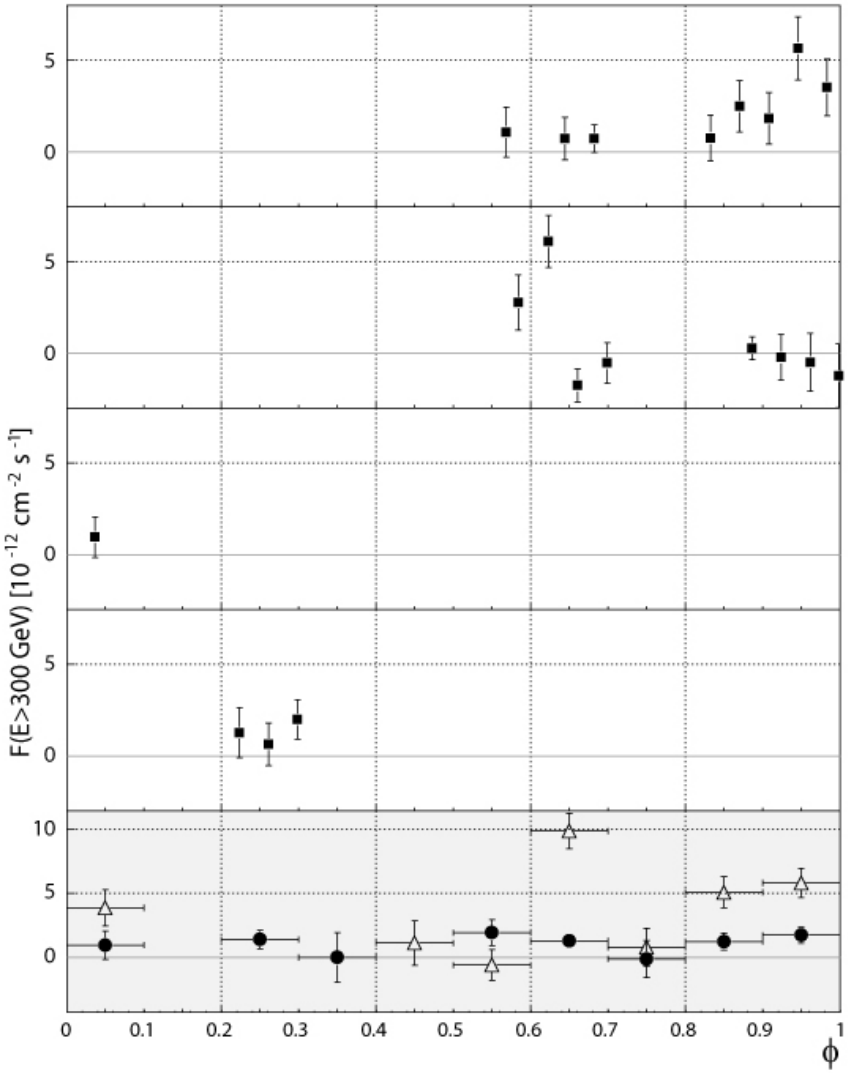
- Observations of consecutive nights with at least 3h obseravtions
- 4 orbital cycles covered
- 48.4h of good quality data

LSI is there

- 6.31 σ detection
- Flux = 1.3 % Crab ($>$ 300GeV)



Periodicity and spectral study



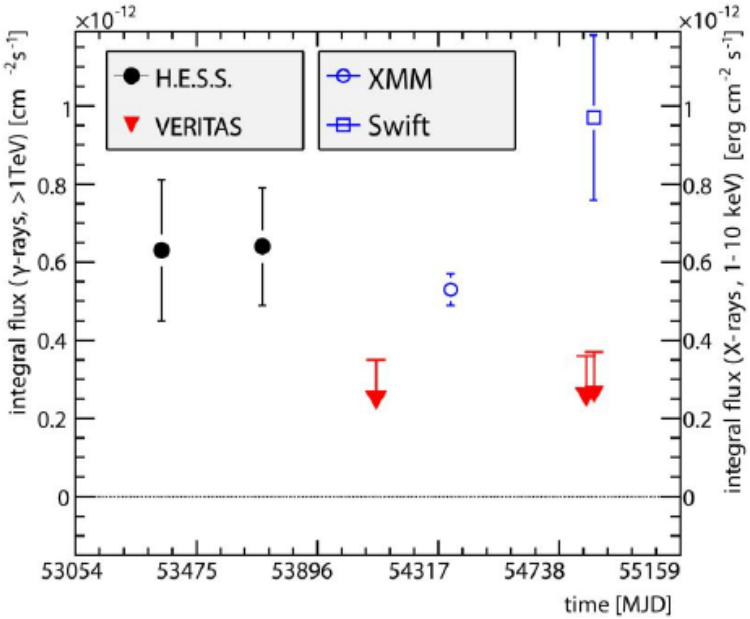
- Flux in phase 0.6-0.7 reduced by a factor 10
- Maximum flux at phase 0.62 with $\approx$ 5.4% crab
- Spectrum comparable to previous measurment

Possible Explanation

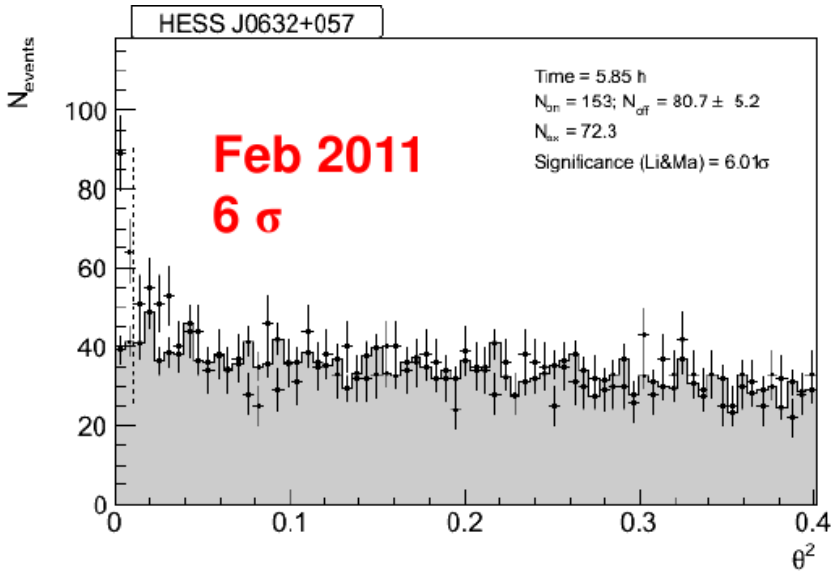
Increase of the stellar wind
$\Rightarrow$ cascading effects

HESS J0632+057

- Discovered by H.E.S.S.
- Variable due to non detection by VERITAS
- Variable X-ray source at same position
- Possible binary, Be star MW148 position is comparable with VHE and X-ray sources
- no clear binray signs in radial velocity measurments



Outburst in January&February 2011



- Swift-XRT (Atel #3152)
  - flux increas by a factor 3 from Jan 23th 2011 on till at least Feb 6th
  - probably binary with orbit of 310-320 days
- VERITAS (Atel #3153)
  - 7&8 February 2011 detected with 8 σ in 5.6h
  - Flux $\approx$ 4% crab $>$ 400 GeV
- MAGIC (Atel #3161)
  - 7-9 February 2011 detected with $>$ 5 σ
  - Flux $\approx$ 3.4% crab $>$ 200 GeV

Summary & Outlook

Summary

- End of MAGIC phase I
  - Cygnus X-3 95 %UL ($>$250GeV) of 1.3% crab
  - J1954 95 %UL ($\approx$1TeV) of 3% crab
  - J1958 95 %UL ($\approx$1TeV) of 2% crab
- Start of MAGIC phase II
  - Detected LSI+61 303 ($<$50h); Flux ($>$300GeV) 1.3% crab
  - Detected HESS J0632+057 ($<$6h); Flux ($>$200GeV) 3.4% crab
  - ...

Outlook

- New galactic sources will probably be weak and/or extended
- More news to come on the conferences this summer